CIC ENGINEERING

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Micro Multi-Purpose Input Simulator (MPIS)

CIC P/N: uMPIS

µMPIS Overview

The µMPIS test box is a general-purpose test box that generates signals used to control the inputs of an electronic control module (ECM) or similar device. A bussed network of small printed circuit boards generate the PWM/frequency signals. A master PCB generates the quadrature signals and remembers the settings of the individual sensor modules. A LCD display is used to show the state of the most recently changed sensor channels. A green power LED is used to indicate when power is applied to the unit. A red and black tip jack is available to allow for easy connection to +Batt and –Batt with a meter. The µMPIS test box is assembled in a sloped enclosure designed to set on top of a desk or shelf. Each µMPIS unit is completely tested and calibrated before it ships.

µMPIS Features

- 13VDC-32VDC input power (lower and higher input voltages are possible, see power input section below)
- 24 sensor outputs – each output is configured with switches:
  - 500 Hz PWM (0-100% duty cycle)
  - 5kHz PWM (0-100% duty cycle)
  - Variable Frequency (50% duty cycle)
  - Variable Frequency / Variable Duty Cycle
  - External signal
  - Selectable output voltage between 5V and 12V (1 channel fixed to +Batt)
- 42 switch to battery or switch to ground outputs with external signal input
- 10 analog outputs (passive or active) with external signal input
- 4 ECM supply voltage inputs
- 4 quadrature frequency outputs (0-5V) with external signal input
- Each output except the switch outputs can be faulted to battery, ground, and open
- Each output has an easily accessible tip jack for monitoring with a scope or meter

µMPIS Contents

A µMPIS ships with the following items:
Qty 1 µMPIS unit
Qty 1 µMPIS set of electrical prints

µMPIS Connections

The µMPIS unit is powered from an external 13VDC-32VDC power supply (not supplied). The external power supply is connected using a set of banana jacks on the right side of the unit. The four red jacks are connected internally. The four back jacks are connected internally. There is a breaker on the power input to the unit that can be used as a power switch.

The outputs generated by the µMPIS unit are brought to 3 40-pin Deutsch connectors on the right side of the unit. The external input signals are brought to 2 70-pin Deutsch connectors on the left side of the unit. The pinout of these connectors are documented in the electrical prints shipped with each unit.

µMPIS Power Input

The µMPIS is designed to work at a 100% duty cycle with a nominal power input of 13VDC to 32VDC. A simple linear regulator has been installed that is used to limit the internal +Batt voltage to less than 33V and provide over voltage protection. This linear regulator will allow for higher input voltages to be used for a short time. A temperature switch has been installed in series with the output of the linear regulator that will shut the unit off if the internal temperature is too high. The maximum voltage that can be applied to the µMPIS is 70VDC. If the unit overheats and shuts itself off then leave the door open for several minutes to allow for cool down. The cause of overheating (typically high input voltage) should be determined and repaired before normal operation is resumed.

The over voltage protection system can be bypassed by installing a wire jumper inside the unit. If the BATT_REG and BATT_SW terminals are jumpered with a 14AWG wire the over voltage protection circuit will be bypassed. This will change the nominal input range to 12VDC to 32VDC. The absolute maximum input voltage with the OVP bypassed is 35VDC. Any voltage higher has the potential to destroy the DC-DC converter.

The incoming current input of the µMPIS is based on the input voltage. The µMPIS draws approximately 1.5A at 27.6V. The µMPIS draws approximately 3.8A at 13V. This change in current input is due to the buck/boost DC-DC converter used inside the µMPIS. The DC-DC converter will be either mounted on the master PCB or on the rear of the enclosure.

The faulting power for the sensor modules has a 0.75A breaker protecting the traces of the sensor modules. This breaker also protects the pull-up voltage on sensor channel 24.

µMPIS Operation

Sensor Outputs
The sensor section of the unit is capable of producing a variable frequency variable duty cycle signal. The output can be configured to lock the duty cycle at 50% or lock the frequency at either 500Hz or 5KHz.

The duty cycle and frequency is controlled using an infinite-turn rotary quadrature encoder. The duty cycle can range from 0% to 100%. The frequency is adjustable between 1 and 10Khz. Each encoder also has a built-in pushbutton. This pushbutton is used to select the various modes of operation. LEDs indicate the current mode of operation. The output voltage is selectable between 5V and 12V with a toggle switch. Sensor 24 has a fixed output voltage of +Batt. This is typically used as the R-term input.

Each output can be faulted to one of three conditions. An output can be faulted to ground, to battery, or can float open. Two switches control the faulting. One switch controls the type of fault (battery, ground, or open) and the other switch controls whether to apply the fault.

Each sensor module can be put into external mode. External mode will disconnect the internal circuitry of the µMPIS and connect the external input pin to the ECM output pin. A channel in external mode can be still be faulted.

Switch Outputs

There are 42 switch outputs available. There are two general types of switch outputs. A switch to ground connects the ECM input to the ground of the µMPIS unit. A switch to battery connects the ECM input to the battery voltage of the µMPIS unit.

All 42 of the switches are 3-position switches that select between short to battery, short to ground, and an open circuit.

Each switch output can be accessed from both the ECM connectors and the external connectors. The switch outputs are routed to the external connector to allow for easy wiring of items such as joysticks. Unlike the other channels on the µMPIS the switch channels do not have the internal circuitry disconnected when used with external devices. The external input pin is always connected to the ECM output pin. This means that the external device and the internal switch are connected in parallel.

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If using the external feature of the switch outputs the switches should be set to the open position or shorting +Batt to –Batt is possible.

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Quadrature Frequency Outputs

There are four quadrature frequency outputs. A quadrature frequency signal shifts the base signal by 180 deg, 90 deg, and 270 deg. All the phase shifts are available on different pins of the Deutsch connector. A 2-position normal/invert switch is available that will swap the 90 and 270 signal to simulate a direction change in the signal.

Each phase-shifted signal can be faulted to one of three conditions. An output can be faulted to ground, to battery, or can float open. Two switches control the faulting signals. One switch controls the type of fault (battery, ground, or open) and the other switch controls whether to apply the fault.

Each quadrature channel can be put into external mode. External mode will disconnect the internal circuitry of the µMPIS and connect the external input pin to the ECM output pin. A channel in external mode can be still be faulted. All four phases of the quadrature channel have a common internal/external selection switch.

Analog Outputs

There are 10 analog outputs. Each analog channel can be configured as either passive or active. The sensor power/return of the analog outputs are connected to the ECM supply 1 input.

A passive sensor is a potentiometer with an open circuit on one end and sensor return on the other end. The output signal is connected to the wiper of the potentiometer therefore the output is a variable resistance to sensor return. This configuration would simulate a 2-wire sensor. All voltage in a passive analog circuit is sourced by the ECM input pin.

An active sensor is a potentiometer with a voltage on one end and sensor return on the other end. The output signal is connected to the wiper of the potentiometer therefore the output is a variable voltage to sensor return. This configuration would simulate a 3-wire sensor. All voltage in a active analog circuit is sourced by the ECM supply pin.

Each output can be faulted to one of three conditions. An output can be faulted to ground, to battery, or can float open. Two switches control the faulting. One switch controls the type of fault (battery, ground, or open) and the other switch controls whether

to apply the fault. If the ECM supply input that is supplying power to the active analog circuits is faulted then the fault voltage (+Batt or –Batt) will be applied to the source end of the potentiometer instead of the ECM supply voltage. This may result in a voltage as high as +Batt being applied to the analog input.

Each analog channel can be put into external mode. External mode will disconnect the internal circuitry of the µMPIS and connect the external input pin to the ECM output pin. A channel in external mode can be still be faulted.

ECM Supply Input
There are 4 ECM supply inputs. ECM supply input 1 is used as the power/supply of the analog outputs in active mode. ECM return 1 is used as the common/return of the analog outputs.

Each input can be faulted to one of three conditions. An input can be faulted to ground, to battery, or can float open. Two switches control the faulting. One switch controls the type of fault (battery, ground, or open) and the other switch controls whether to apply the fault. Only the supply side of the sensor supply can be faulted. A faulted condition will place the fault voltage on the analog output channels. If ECM supply 1 is faulted to +Batt then the analog outputs will use +Batt as the power/supply rather than the ECM supplied voltage.

Speed Timing Outputs
Sensor 22 has 3 additional tip jacks associated with it. These 3 additional signals are the speed timing signals. The master processor can generate signals that can be used to drive the speed timing input on an engine controller. The master processor uses the frequency encoder on sensor 22 to determine how fast to generate the speed timing signals. The waveforms available on the uMPIS unit can be user defined and can be changed via the uMPIS Control software package.

Other Features

There is an uMPIS Control software package that allows for control of the uMPIS unit using a serial port. The software package allows the state of the channels to be saved, loaded, and edited using the software. The software also allows for custom speed timing waveforms to be imported and then downloaded to the uMPIS unit. Refer to the PC control document for additional details on the uMPIS Control software.

The µMPIS unit has a 4x20 LCD display. This display is used to show the state of the last 2 or 4 channels adjusted. The LCD screen also is used to show the software revisions of the sensor modules. At power-up the uMPIS will default to the channel display screen. Use the ESC toggle switch to return to the menu. The menu has 4 items on it. “CHANNEL DISPLAY” will go to the screen that shows the status of the sensor modules. While on the channel display screen the up/down switch is used to select whether 2 or 4 channels are shown.

“REVISION LEVELS” will show the software revisions of all of the sensor modules installed in the unit. and the master PCB firmware revision.

“SPEED TIMING” will enter a menu that shows all of the available speed timing signals currently loaded on the uMPIS. The menu entry designated with a * is the waveform currently being generated. The entry designated with a > is the currently selected entry on the menu. Use the up/down switch to scroll through the menu and change the currently selected entry. The enter switch will change what waveform is currently being generated. Refer to the PC control document for additional details on how to configure the waveforms available.

“ABOUT CIC” will show the CIC Engineering’s contact information.

Additional features of the master PCB will be added in the future as needed or requested by Cat.

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The master PCB polls the state of the individual sensor modules and stores the sensor setup information at power down in the internal flash of the microprocessor. A 1.5F capacitor is used to provide power to the MCU during the flash writing. The unit has to be turned on for at least 2 minutes for any changes to the sensor setup to be saved. This 2 minute delay is there to ensure the capacitor has charged sufficiently to power the MCU. These settings are restored to the individual modules at power up.

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The values displayed on the LCD display are for reference only. The values represent the commanded values by the microprocessor. Actual measurements with a calibrated instrument may differ.

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